# Curriculum Vitae

Robert M. Corless

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## Contents

# 1 Summary

## 1.1 Position

Professor and Chair
Department of Applied Mathematics
University of Western Ontario

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|---|---|
| 7/1/2002–6/30/2007 | Chair, Applied Mathematics |
| 7/1/1999–9/30/2005 | Deputy Director, Ontario Research Centre for Computer Algebra |
| 7/1/1998– | Professor, Applied Mathematics |
| 7/1/1998– | Associate Researcher, Boundary Layer Wind Tunnel |
| 7/1/1993–6/30/1998 | Associate Professor with tenure, Applied Mathematics |
| 7/1/1987–6/30/1993 | Assistant Professor, Applied Mathematics |

## 1.2 Degrees

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| 1987 | Ph. D. | University of British Columbia, Mechanical Engineering |
| 1982 | M. Math | University of Waterloo, Applied Mathematics |
| 1980 | B. Sc. (Hons) | UBC, Mathematics & Computer Science |
| 1976 | High School | Duchess Park, Prince George, B. C. |

## 1.3 Honours

- 2006–, Distinguished University Professor, UWO
- 2005–, Honorary Professor, Dept. Philosophy, UWO
- 2004 NSERC Synergy Award (Team Member, $10,000 to UWO)
- July 2001, ISSAC Best poster award: Ilias S. Kotsireas, André Galligo, Robert M. Corless, & Stephen M. Watt, "A Symbolic-Geometric Multivariate Factorization Method".
- February 2001 Mapstone Lecturer, SUNY Geneseo. "Computer Technology in Science and Math Education"
- January 2001 After-dinner speaker at ANODE, Auckland, New Zealand, at the invitation of Professor John Butcher: "Time Marches On".
- 1999–2000 Faculty of Science Distinguished Research Professorship
- 1997–present, Honorary Professor, Dept. Computer Science UWO
- 1998–1999 Faculty of Science Teaching Award of Excellence

## 1.4 Lifetime Statistics

### 1.4.1 Students and PDFs

I have graduated 9 Ph.D. students and 7 Masters students, and am currently co-supervising 2 graduate students. I have supervised 5 post-doctoral fellows.

### 1.4.2 Research Papers

The total is 49 Category I papers (see section 3.1), 27 Category II papers, 32 unrefereed publications, and 3 book reviews. In addition, there are 2 papers in progress and 9 submitted. Fourteen further papers reported in my Teaching Dossier are counted separately, and not listed in this document. About one-quarter of my papers are written with D.J.Jeffrey (and others), and about one-fifth are single-author. In total, I have written papers with more than sixty different people, and published in more than twenty different journals.

### 1.4.3 Software Packages

I have developed 26 small software packages for symbolic computation; some were originally made available in the Maple share library and most of the recent contributions have been incorporated into Maple itself. I believe that good software packages are more useful to the academic community than even refereed journal papers.

### 1.4.4 Talks

I have given over 80 invited and conference talks. My students have now given a total of over 20 further talks at various conferences.

### 1.4.5 Books

One book, *Essential Maple* (now in 2nd edition), and two chapters in books, have been published internationally (Springer-Verlag and NAG, Inc. are the publishers). One further book chapter, *Linear Algebra in Maple*, will appear in 2006 in the new CRC Handbook of Linear Algebra.

## 1.5 Five Best Papers

### 1.5.1 The SVD for Polynomial Systems

This is paper no. 32 in the list on p. 10. On my first sabbatical I was invited to visit IBM T. J. Watson Research Center, a world-class institution for computer science research. During that time I wrote the paper "The Singular Value Decomposition for Polynomial Systems", with Barry Trager, Patrizia Gianni, and Stephen Watt. This work is perhaps the most significant scientific computing work I have done to date. The SNAP (Symbolic-Numeric Algorithms for Polynomials) series of conferences began in 1996 in Sophia-Antipolis, France in order to discuss some of the consequences of the ideas raised in this paper. There have since been 3 further SNAP mini-conferences held in conjunction with SIAM. I was an invited

speaker at the most recent full conference in this area, SNC at Xi'an, China. I continue to be active in this area, and a new development is discussed in section 1.5.3.

### 1.5.2 The Lambert $W$ Function

This is paper no. 28 in the list on p. 9. In 1992, D.J.Jeffrey, Dave Hare, Gaston Gonnet and I wrote a paper on the function which satisfies $w\exp(w) = x$, which we traced back to J. H. Lambert and named after him. The journal reviews of this paper were very complimentary, when we submitted it for publication, and it could have appeared already in 1994. Gaston Gonnet brought the paper to the attention of D. E. Knuth, who responded with a substantial collection of notes on this function which he had been working on himself for several years. It was very gratifying to find that we had been working on something that someone of Knuth's stature found interesting, and to have made progress that he admired.

We adopted some of Knuth's material into a revised version of the paper, and he became a co-author. This has since led to a fruitful collaboration, with two more papers with Knuth so far, and more in progress.

The material of the first $W$ paper ranges in level from simple, *i.e.* accessible by even first-year undergraduates, to quite deep, and manages to show most undergraduate mathematics in a new light along the way. The significance of this work is perhaps not so much its depth but its utility. The Lambert $W$ function is very simple, and has applications in an extraordinary number of fields, ranging from analysis of algorithms in computer science through fluid mechanics to pure mathematical results in dynamical systems. Most recently it has attracted attention in various branches of the physics research community.

### 1.5.3 Polynomial Algebra by Values

This is paper no. 6 in the list on p. 17. It is perhaps perverse to list an as-yet unpublished paper as one of my most significant: however, this paper has more ideas per page than practically any of my other papers, and has generated so far two Ph.D. theses and a Masters' thesis, and ten further papers have already appeared or been submitted as a result of this paper. More will come out of this, yet. The basic idea is (in retrospect) quite simple: do all desired polynomial algebra directly on the values given by data, instead of first converting to some basis (usually a monomial basis). The paper gives methods to divide (multivariate) polynomials given by values, construct eigenproblems giving the common zeros, and the revised version will show how to compute Gröbner bases.

### 1.5.4 Error Backward

This is paper no. 35 in the list on p. 10. Numerical methods for chaotic dynamical systems can often work, even when the classical theory says they shouldn't. Explaining why this is so, and coming up with a reliable means of telling when numerical results can be trusted and when they can't, is of extreme significance for engineering simulations of nonlinear systems. This is particularly important for the modern engineer who often uses pre-packaged software.

This paper, which culminates a series of papers on defect control for chaotic dynamical systems, answers the question completely, in the sense that it shows how to turn the question

of reliability of the software into a question of reliability of the mathematical model, which of course has to be answered anyway.

#### 1.5.5 Continued Fractions and Chaos

This is paper no. 41 in the list on p. 10. This paper, which originally appeared as the cover article for the American Mathematical Monthly in March 1992, has been reprinted in a special volume (Canadian Math Society Proceedings, vol. 20 ) as the Proceedings of the Organic Mathematics Workshop (see section 6.2). I am somewhat diffident about putting this paper in a list of my 'best' because I was also an editor of that proceedings; nonetheless the paper was chosen out of several possibilities not by me but by my co-editors.

The *content* of the paper has served as the basis for my understanding of the interaction of numerical methods and chaotic dynamical systems, and has stood up remarkably well in the face of rapid progress in the area.

### 1.6 Teaching Summary

In short, I rank teaching above research in terms of its impact on society—but with the caveat that teaching should be *informed* by active research. The kicker (punchline) is that active research provides a lifeline and rationale for teaching: you then know *why* you are teaching what you are teaching, and why it's important. There is another consideration, equally important and less valued these days than the 'novelty' of research: teaching should be informed by *scholarship*, by which I include the conservation elements: we need to keep alive some very powerful results and methods of thinking, in part because they may prove useful, in part because they help develop our neural pathways and help us to think, but also simply because they are part of our heritage.

### 1.7 Service Summary

I was Deputy Director of the Ontario Research Centre from 1999–2004, and Chair of the Department of Applied Mathematics July 1, 2002 till June 30, 2007. I have had many successes in that time, detailed below in section 8.

## 2 Research Interests

### 2.1 Scientific Computing

I view *Scientific Computing* as computer science in the service of science and engineering. I am primarily interested in the symbolic and numerical computation aspects of scientific computing. In 1997 I accepted the position of 'Honorary Professor' in the Department of Computer Science.

## 2.2 Engineering

My work on mathematical modelling for flow-induced vibration has proved to be a touchstone for my work in scientific computing. By working on scientific computing problems that arose directly from this practical problem of engineering interest, I ensured that the results I discovered actually served at least one real purpose. I have now shifted my focus from flow-induced vibration problems to symbolic-numeric algorithms for polynomials, which have industrial applications in computer-aided geometric design; these are now my engineering application touchstone problems. For the future I am considering delay-differential equations (functional differential equations) and exponential polynomials as generalizations and unifications with my work on Lambert $W$, with the motive of moving towards work in mathematical biology: specifically on mathematical modelling of Stargardt's disease, a hereditary blindness that, not coincidentally, afflicts two of my brothers.

## 2.3 Mathematics

It is no longer possible to do either engineering or computer science in a way that is divorced from mathematics, if indeed it ever was. Work on my original 'touchstone' problem above has led directly to work in dynamical systems, and indirectly through scientific computing to work on approximate polynomial systems. The new touchstone problems involve much classical algebra, and novel mathematics intended to make the classical results robustly algorithmic.

# 3 Papers and Software

## 3.1 Ranking of Publication Vehicles

Category I means top-ranked journals and equivalent refereed proceedings, category II means refereed at a 'moderate' or standard level, while category III is unrefereed.

## 3.2 Category I Papers

### 3.2.1 Description of Category I Journals and Proceedings

**Note**: The Proceedings of the annual International Symposium on Symbolic and Algebraic Computation (ISSAC) are Category I, because they receive full refereeing and have a rejection rate of between 60% and 80%, and because the ISSAC meetings are regarded as the premiere symbolic computation conference in the world.

### 3.2.2 List of Category I Papers

1. Robert M. Corless, Hui Ding, Nicholas J. Higham, and D.J.Jeffrey, "The solution of $S \exp S = A$ is not always LambertW($A$)", Proc. ISSAC 2007.

2. Robert M. Corless & Dawit Assefa, "A Case Study on Elliptic Functions in a CAS: Jeffery-Hamel Flow in Maple", Proc. ISSAC 2007.

3. Amir Amiraslani, Dhavide Aruliah & Robert M. Corless, "Block *LU* Factors of Generalized Companion Matrix Pencils", accepted Theoretical Computer Science, 2007.

4. Robert M. Corless, Nargol Rezvani, & Amir Amiraslani, "Pseudospectra of matrix polynomials expressed in alternative bases", Mathematics and Computer Science, accepted 2007.

5. M. Bronstein, Robert M. Corless, James H. Davenport, & D.J.Jeffrey, "Algebraic Properties of the Lambert $W$ Function", Integral Transforms and Special Functions, accepted May 2006.

6. Jichao Zhao, Matt Davison, & Robert M. Corless, "Compact finite difference method for American option pricing", Journal of Compuational and Applied Mathematics, Volume 206, pp. 306–321 (2007).

7. Jichao Zhao, Tie Zhang, & Robert M. Corless, "Convergence of the compact finite difference method for second-order elliptic equations", Appl. Math. Comput. 182, No. 2, 1454–1469 (2006).

8. Jichao Zhao & Robert M. Corless, "Compact Finite Difference Method for Integro-Differential Equations", Appl. Math. Comput. 177, No. 1, 271–288 (2006).

9. Silvana Ilie, Robert M. Corless, & Gregory J. Reid, "The numerical solution of index-1 DAE is of polynomial cost in the number of bits requested", Numerical Algorithms, Volume 41, No. 2, 2006, pp. 161–171.

10. Robert M. Corless, Stephen M. Watt, & L. Zhi, "QR Factoring to Compute the GCD of Univariate Approximate Polynomials", IEEE Transactions on Signal Processing, 52 (12) Dec 2004, 1–9.

11. D. A. Aruliah & Robert M. Corless, "Numerical Parameterization of affine varieties using ODEs", Proc. ISSAC, ed. J. Gutierrez, Santander (2004) 12–18.

12. Robert M. Corless, L. Gonzalez-Vega, I. Necula, & Azar Shakoori, "Topology Determination of Implicitly Defined Real Algebraic Plane Curves, An. Univ. Timisoara Ser. mat.-Inform., 41 (Special Issue): (2003) pp. 83–96.

13. R. J. Bradford, Robert M. Corless, James H. Davenport, D.J.Jeffrey, & Stephen M. Watt, "Reasoning about the elementary functions of complex analysis", Annals Maths Artificial Intelligence, vol 36, 2002, 303–318.

14. Robert M. Corless, "A New View of the Computational Complexity of Initial Value Problems for Ordinary Differential Equations", Numerical Algorithms, 31 (2002) 115-124.

15. Robert M. Corless, André Galligo, Ilias S. Kotsireas, & Stephen M. Watt, "A Geometric-Numeric Algorithm for Absolute Factorization of Multivariate Polynomials", Proc. ISSAC, ed. T. Mora, Lille, (2002) 37-45.

16. Robert M. Corless, Mark W. Giesbrecht, Mark van Hoeij, Ilias S. Kotsireas, & Stephen M. Watt, "Towards factorization of approximate polynomials", Proc. ISSAC, ed. B. Mourrain, London, (2001) 85–92.

17. Robert M. Corless, "Symbolic-Numeric Algorithms for Polynomials: some recent results", in Symbolic-Algebraic Methods and Verification Methods, Alefeld, Rohn, Rump & Yamamoto, eds,[Dagstuhl, 1999] *pp.* 21–33 (2001).

18. Robert M. Corless & Lawrence F. Shampine, "Initial value problems for ODEs in Problem Solving Environments", Journal of Computational and Applied Mathematics, Volume 125, *pp.* 31–40 (2000).

19. E. Kaltofen, "Challenges in Symbolic Computation", Journal of Symbolic Computation, Volume 29, No. 6, *pp.* 819–919 (2000), with an appendix by Robert M. Corless & D.J.Jeffrey.

20. Jonathan M. Borwein & Robert M. Corless, "Emerging Tools in Experimental Mathematics", American Mathematical Monthly, Volume 106, *pp.* 889–909, December (1999).

21. Robert M. Corless, Mark W. Giesbrecht, D.J.Jeffrey, & Stephen M. Watt, "Approximate polynomial decomposition", Proc. ISSAC, S. Dooley, ed, Vancouver, *pp.* 213–220 (1999).

22. Edward Katende, Arthur Jutan, & Robert M. Corless, "Quadratic non-linear predictive control", Industrial and Engineering Chemistry Research, Volume 37, *pp.* 2721–2728 (1998).

23. Paulina Chin, Robert M. Corless, & George F. Corliss, "Optimization strategies for the approximate GCD problem", Proc. ISSAC, O. Gloor, ed, Rostock, *pp.* 228–235 (1998).

24. D.J.Jeffrey, D. E. G. Hare, & Robert M. Corless, "Exact rational solutions of a transcendental equation", Comptes Rendus (Mathematics) Volume 20, No. 3, *pp.* 71–76 (1998).

25. Robert M. Corless, D.J.Jeffrey, Pratibha, & M. B. Monagan, "Two perturbation calculations in fluid mechanics using large expression management", Journal of Symbolic Computation, Volume 23, *pp.* 427–443 (1997).

26. Robert M. Corless, P. M. Gianni & B. M. Trager, "A reordered Schur factorization method for zero-dimensional polynomial systems with multiple roots", Proc. ISSAC, W. Küchlin, ed, Maui, July 20–23, *pp.* 133–140 (1997).

27. Robert M. Corless, D.J.Jeffrey & Donald E. Knuth, "A sequence of series for the Lambert $W$ function", Proc. ISSAC, W. Küchlin, ed, Maui, July 20–23, *pp.* 197–204 (1997).

28. Robert M. Corless, G. H. Gonnet, D. E. G. Hare, D.J.Jeffrey, & Donald E. Knuth, *On the Lambert W Function*, Advances in Computational Mathematics **5** (1996) 329–359.

29. D.J.Jeffrey, Robert M. Corless, D. E. G. Hare, & Donald E. Knuth, *Sur l'inversion de $y^\alpha e^y$ au moyen des nombres de Stirling associés*, Comptes Rendus de L'Académie des Sciences, Paris, 320, 1, 12 (1995), 1449–1452.

30. Robert M. Corless & S. Yu. Pilyugin, "Approximate and Real Trajectories for Generic Dynamical Systems", J. Mathematical Analysis & Applications 189 (1995) 409–423.

31. Robert M. Corless & S. Yu. Pilyugin, "Evaluation of Upper Lyapunov Exponents on Hyperbolic Sets", J. Mathematical Analysis & Applications 189 (1995) 145–159.

32. Robert M. Corless, P. M. Gianni, B. M. Trager, & S. M. Watt, "The Singular Value Decomposition for Polynomial Systems", Proc. ISSAC, A. H. M. Levelt, ed., Montréal, July 10–12 (1995) 195–207.

33. Robert M. Corless, "Symbolic Computation in Nonlinear Dynamics", Open Systems and Information Dynamics vol. 3 (1) (1995) 131-148.

34. Robert M. Corless, "Bifurcation in a Flow-Induced Vibration Model", Proceedings of the Fields Institute Workshop on Normal Forms and Homoclinic Chaos, 1992, W. F. Langford & W. Nagata, eds, Fields Institute Communications, vol. 4, (1995) 43–59.

35. Robert M. Corless, "Error Backward", Proceedings of Chaotic Numerics, Geelong, 1993, P. Kloeden & K. Palmer, eds, AMS Contemporary Mathematics **172** (1994) 31–62.

36. Robert M. Corless, "What good are numerical solutions of chaotic differential equations", Computers in Mathematics with Applications, **28** 10–12, *pp.* (1994) 107–121

37. Robert M. Corless, "Sufficiency Conditions in the Calculus of Variations", Proc. ISSAC, J. von zur Gathen & M. Giesbrecht, eds, Oxford, U.K. July (1994) 197–204.

38. Amanda G. Connell & Robert M. Corless, "An Experimental Interval Arithmetic Package in Maple", *Interval Computations*, No. 2 (1993) 120–134.

39. Robert M. Corless & G. V. Parkinson, "Mathematical modelling of the combined effects of vortex-induced vibration and galloping, Part II", J. Fluids & Structures 7, (1993) 825–848.

40. Robert M. Corless, "Defect-Controlled Numerical Methods and Shadowing for Chaotic Differential Equations", Physica D vol. 60 (1992) 323–334.

41. Robert M. Corless, "Continued Fractions and Chaos", *The American Mathematical Monthly* vol. 99, no. 3, March (1992) 203–215. *This article has been made 'organic': see section (6.2).*

42. Robert M. Corless & Honglin Ye, "Solving linear integral equations with Maple", Proc. ISSAC Berkeley, CA, July 27–29 (1992) 95–103.

43. Robert M. Corless, D.J.Jeffrey, & H. Rasmussen, "Numerical Evaluation of Airy functions with complex arguments", J. Comp. Physics vol. 99, no. 1, March (1992) 106–114.

44. Robert M. Corless, G. C. Essex, & M. A. H. Nerenberg, "Numerical methods can suppress chaos", Physics Letters A, 157, 1, (1991) 27–36.

45. Robert M. Corless, G. W. Frank, & J. Graham Monroe, "Chaos and Continued Fractions", Physica D 46 (1990) 241–253.

46. Robert M. Corless & D.J.Jeffrey, "Solution of a hydrodynamic lubrication problem with Maple", J. Symbolic Computation 9 (1990) 503–513.

47. Robert M. Corless & G. V. Parkinson, "A model of the combined effects of vortex-induced vibration and galloping", J. Fluids & Structures 2 (1988) 203–220.

48. Robert M. Corless & D.J.Jeffrey, "Stress moments of nearly touching spheres in low Reynolds number flows", ZAMP 39 (1988) 874–884.

49. D.J.Jeffrey & Robert M. Corless, "Forces and stresslets for the axisymmetric motion of nearly touching unequal spheres", J. Physico-Chemical Hydrodynamics, vol. 10, no. 4 (1988) 461–470.

### 3.2.3 Papers submitted

1. G. C. Essex, Silvana Ilie, and Robert M. Corless, "Symmetry Breaking and Long-Term Forecasting", submitted January 2007.

2. Amir Amiraslani, Peter Lancaster & Robert M. Corless, "Linearization of Matrix Polynomials Expressed in Polynomial Bases ", submitted November 2006.

3. Silvana Ilie, Robert M. Corless, & G. C. Essex, "The computational complexity of extrapolation methods", submitted October 2006.

4. Amirhossein Amiraslani, Dhavide Aruliah, & RMC, "The Rayleigh Quotient Iteration for Generalised Companion Matrix Pencils", submitted July 2006.

5. Robert M. Corless, Karin Gatermann, & Ilias S. Kotsireas, "Using symmetries in the eigenvalue method for polynomial systems", submitted January 2006 (not received till February 2007).

6. Pei Yu & Robert M. Corless, "Symbolic computation of limit cycles associated with Hilbert's 16th problem", submitted October 2005.

7. Robert M. Corless & Silvana Ilie, "The numerical solution of index-$n$ DAE is of polynomial cost", submitted 2005.

8. Robert M. Corless & D.J.Jeffrey, "Complex numerical values of the Wright $\omega$ function", submitted July 2004.

9. Robert M. Corless & D.J.Jeffrey, "Computer algebra support for the Wright $\omega$ function", submitted July 2004.

### 3.2.4 Papers in Progress

1. Robert M. Corless & Patrizia M. Gianni & Barry M. Trager, "Approximate GCD, or, Schönhage's algorithm revisited."

2. Robert M. Corless. Conversations on the Lambert $W$ function.

## 3.3 Category II Papers

### 3.3.1 Description of Category II Journals and Proceedings

Lower-ranked journal- and conference proceedings papers are listed here. Usually the motive for publishing in these vehicles is convenience, or appropriateness to the audience, or a wide readership.

### 3.3.2 List of Category II Papers

1. Dhavide Aruliah, Robert M. Corless, Laureano Gonzalez-Vega, and Azar Shakoori, "Geometric Applications of the Bezout Matrix in the Bivariate Tensor-Product Lagrange Basis", Proc. SNC 2007, London, Canada.

2. Dhavide Aruliah, Robert M. Corless, Laureano Gonzalez-Vega, Ignacio F. Rua, and Azar Shakoori, "Computing the Topology of a Real Algebraic Plane Curve whose Equation is not Directly Available", Proc. SNC 2007, London, Canada.

3. Dhavide Aruliah, Robert M. Corless, Laureano Gonzalez-Vega, and Azar Shakoori, "Companion Matrix Pencils for Hermite Interpolants", Extended abstract, Proc. SNC 2007, London, Canada.

4. Robert M. Corless & Nargol Rezvani, "The Nearest Polynomial of Lower Degree", Spring 2007 completion, est. (Preliminary version published as Technical Report TR-06-03 at http://www.orcca.on.ca/TechReports). Extended abstract, Proc. SNC 2007, London, Canada.

5. Wenqin Zhou, D.J.Jeffrey, & Robert M. Corless, "Fraction-free forms of $LU$ and $QR$ matrix factors", Proc. Transgressive Computing, Granada, (2006) pp. 443–446.

6. Robert M. Corless, Silvana Ilie, & Greg Reid, "Computational complexity of numerical solution of Polynomial Systems", Proc. Transgressive Computing, Granada, (2006) pp. 405–410.

7. Jichao Zhao, Yinbin Lin, Li Ma, & Robert M. Corless, "A Highly efficient and accurate algorithm for solving the Partial Differential Equation in Cardiac Tissue Models", accepted WSEAS 2006.

8. Robert M. Corless, "On a Generalized Companion Matrix Pencil for Matrix Polynomials Expressed in the Lagrange Basis", Proc. Symbolic-Numeric Computation, Xi'an, China, D. Wang & L. Zhi, eds, (2005) 1–18. *republished in Symbolic-Numeric Computation, Birkhauser, D. Wang & L. Zhi, 2006, pp. 1–16.*

9. J. Zhao, Robert M. Corless, & Matt Davison, "Financial Applications of Symbolically Generated Compact Finite Difference Formulae", Proc. Symbolic-Numeric Computation, Xi'an, China, D. Wang & L. Zhi, eds, (2005) 220–234. *republished in Symbolic-Numeric Computation, Birkhauser, D. Wang & L. Zhi, 2006, pp. 346–360.*

10. J. M. Heffernan & Robert M. Corless, "Solving some delay differential equations using computer algebra", the Mathematical Scientist 31, no. 1, (2006) pp. 21–34.

11. Mhenni M. Benghorbal & Robert M. Corless, "A unified formula for arbitrary order symbolic derivatives and integrals of a rational polynomial", Int'l J. Pure and Applied Mathematics, **16**, no. 2 (2004) pp. 193–201.

12. Mhenni M. Benghorbal & Robert M. Corless, "Power series solution of fractional differential equations", Int'l J. Pure and Applied Mathematics, **15**, no. 3 (2004) pp. 333–352.

13. Robert M. Corless, "Computer-Mediated Thinking", Proc. TIME 2004, Montréal. (invited paper, CD proceedings).

14. Robert M. Corless & D.J.Jeffrey, "On the Wright $\omega$ Function", Proc. **XI**th AISC: Artificial Intelligence, Automated Reasoning, & Symbolic Computation, and Calculemus, Marseille, France, July 2002, 76-90.

15. S. R. Valluri, Robert M. Corless & D.J.Jeffrey, "Some Applications of the Lambert $W$ function to Physics", Canadian Journal of Physics, Volume 78, *pp.* 823–831 (2000).

16. D.J.Jeffrey, Mark W. Giesbrecht, & Robert M. Corless, "Integer roots for integer-power-content calculations" In: Computer mathematics, proceedings of the fourth Asian symposium. Editors: Xiao-shan Gao & Dongming Wang. World Scientific, Lecture Notes Series on Computing, Vol 8, (2000) 71–74.

17. Robert M. Corless, Mark W. Giesbrecht, Ilias S. Kotsireas, & Stephen M. Watt, "Numerical implicitization of curves and surfaces", Proc. **X**th AISC, Madrid 2000, Springer LNAI Volume 1930, (2001) 174–183.

18. Robert M. Corless, James H. Davenport, D.J.Jeffrey, G. Litt, & Stephen M. Watt, "Reasoning about the elementary functions of complex analysis", Proc. Xth AISC, Madrid 2000, Springer LNAI Volume 1930 (2001) 115–126.

19. Robert M. Corless, Mark W. Giesbrecht, D.J.Jeffrey, Xianping Liu & Stephen M. Watt, "Approximate Polynomial Decomposition" (extended abstract) Proc. FRISCO Workshop, April 28–29 1999, Oxford, UK, FRISCO Consortium Report 5.6.1 ESPRIT LTR 21.024 (1999).

20. Heinz Bauschke & Robert M. Corless, "Analyzing a Projection Method with Maple", MapleTech (special issue Maple in the Mathematical Sciences), vol. 4, no. 1, 1997, *pp.* 2–7.

21. Anne-Marie E. Allison & Robert M. Corless, "A Bifurcation Study of a Flow-Induced Vibration Model", Proc. American Soc. Mech. Engineering PVP-FIV vol 328, Montréal, July (1996), *pp.* 143–156.

22. D.J.Jeffrey, D. E. G. Hare, & Robert M. Corless, "Unwinding the branches of the Lambert $W$ function", *Math. Scientist* **21** (1996) 1–7.

23. Robert M. Corless & Jacek Rokicki, "The Symbolic Generation of Finite Difference Formulae", Proceedings ICIAM '96, Hamburg, G. Alefeld, O. Mahrenholtz, R. Mennicken, eds, Zeitschrift für Angewandte Mathematik und Mechanik, **76** Supp. 1 (1996) 381–382.

24. T. Scott, G. Fee, Robert M. Corless, & M. B. Monagan, "Applications of Maple to Mathematical, Scientific, and Engineering Problems", Special Issue of MapleTech, (1994) 49–57. (Reprinted from Artificial Intelligence, Expert Systems and Symbolic Computing, E. N. Houstis & J. R. Rice, eds, Elsevier Science Publishers B. V. (1992) 165–176)

25. Robert M. Corless, G. H. Gonnet, D. E. G. Hare, & D.J.Jeffrey, "Lambert's $W$ function in Maple", MapleTech 9 (1993) 12–22.

26. Robert M. Corless & George F. Corliss, "Rationale for Guaranteed ODE Defect Control", Proc. SCAN-91 International Symposium, Oldenburg, Germany (1991).

27. Robert M. Corless, "Chaos in a Flow-Induced Vibration Model", Proc. ASME International Symposium on Flow-Induced Vibrations and Noise, Chicago, M. M. Reischman, M. P. Païdoussis, R. J. Hansen, eds., vol. 7, (1988) 77–85.

## 3.4 Software Packages

Note: "iguana" is the internal name for what will become the next release of Maple. This follows "hydra", which became Maple 9 in 2003, "griffin" which became Maple 8 in 2002, "falcon" which became Maple 7, and so on.

1. `algcurves/plot_real_curve`, routines for visualizing implicit curves, and for computing an implicit representation of a curve, with Ilias Kotsireas and Stephen Watt. Incorporated into Maple 7, 2001.

2. `algcurves/implicitize`, routines for visualizing implicit curves, and for computing an implicit representation of a curve, with Ilias Kotsireas and Stephen Watt. Incorporated into Maple 7, 2001.

3. `BezoutMatrix`, a routine for computing the symmetric Bézout matrix of two polynomials, with Azar Shakoori. Incorporated as an option into Maple 8, 2002.

4. `BivariatePolynomial`, a routine for approximating all solutions of two polynomials in two unknowns, with Azar Shakoori. Incorporated into the RootFinding package, Maple 8, 2002, and improved for Maple 9, 2003.

5. `CompanionMatrix`, a routine for computing the generalized companion matrix pencil of matrix polynomials. Incorporated into Maple 8, 2002, and improved for "iguana", 2004. Updated 2005 to handle Bernstein basis (formula of Joab Winkler, Gudbjorn Jonsson & Steve Vavasis).

6. `dsolve/numeric`, upgrade to rkf45 and a Rosenbrock method for stiff systems, with L.F. Shampine and Allan Wittkopf. Released as NODES, a Maple 6 package, 2000 and incorporated into Maple 7, 2001.

7. `FINDIF`, a routine for generation of finite difference formulae, with Jacek Rockicki and Jichao Zhao. Share Library package 1994, and upgraded to $n$ dimensions for "iguana", 2004.

8. `Fracdiff`, a package for fractional-order differentiation. This and an improvement to `diff` to handle symbolic integer order differentiation, with Mhenni Benghorbal and Ryan Morris. Delivered for Maple "iguana", 2004.

9. `Groebner/SetBasis` and `Groebner/MulMatrix`, routines to construct a basis for the normal set of a Gröbner basis and the multiplication matrices in the quotient ring, whose eigenvalues solve a polynomial system. Incorporated in Maple 7, 2001.

10. HTML-Maple interface for Organic Mathematics (http://www.cecm.sfu.ca, with David Fayegh, Loki Jörgenson 1995 (now obsolete)

11. `Hurwitz`, a routine to discover when a polynomial is stable. Released in the share library 1994, i ncorporated in the Maple 8 package PolynomialTools 2002.

12. `index/circulant` and `index/Vandermonde`, indexing functions for circulant and confluent Vandermonde matrices. Incorporated into Maple 8, 2002.

13. `IISSVD`: Iterative Improvement for Singular Systems using the SVD, with Josef Schicho, 2000; to be improved for "iguana", 2004.

14. `intpak` an experimental interval arithmetic package, with Amanda Connell (Maple Share Library) 1993. Now obsolete and superceded: the package `Intpak-X` by Kramer et. al of U. Wuppertal (2001) builds on and extends our work.

15. `intsolve`, a package for solving integral equations, with Honglin Ye and Ryan Morris. Released as a share library package 1992 and upgraded for "iguana" 2004.

16. `LargeExpressions`, a package to help avoid construction of unnecessarily large expressions, with David Jeffrey. Incorporated into Maple 8, 2002.

17. `LUDecomposition` - Turing factoring option - a routine for factoring matrices with parameters. Released as the share library package RowEchelon in 1993 and incorporated in Maple 6, 2000.

18. `MPOI`: Matrix Polynomial Object Implementation, a data structure and conversion tool for matrix polynomials. Incorporated into Maple 8, 2002. Updated to handle Bernstein basis, and to evaluate polynomials expressed in the Lagrange basis using the barycentric form.

19. `MoorePenrose`, a routine to compute the (discontinuous) Moore-Penrose inverse of a matrix with parameters, with Heinz Bauschke and C.-P. Jennerod. Incorporated as an option into MatrixInverse for Maple 8, 2002.

20. `Perturbation`, a package to perform averaging, multiple scales, center manifold and normal form computations, with Xianping Liu and Jianao Yang. Released as a standalone package 1998 and upgraded for "iguana" 2004.

21. `ProcessOptions/Simple`, an interface to a programming utility. Incorporated into Maple 7, 2001.

22. `QRGCD`, a routine to use QR factoring to compute the GCD of approximate polynomials, with Lihong Zhi and Hiroshi Kai. Incorporated into the SNAP package in Maple 8, 2002.

23. `solve` (parametric option) a routine to produce a parametric solution to $f(x, y) = 0$. Incorporated into Maple 8, 2002.

24. `VariationalCalculus`, a package for sufficiency analysis in the calculus of variations. Released as a share library package 1995 and incorporated into Maple 8, 2002.

25. `Wright`, a package for symbolic and numeric treatment of the Wright $\omega$ function, with David Jeffrey. Released as a standalone package 2001 and improved for Maple "iguana" 2004.

26. Various other modifications, bug fixes, improvements, including `simplify/LambertW`, `CurveFitting/PolynomialInterpolation`, and `OrthogonalSeries`.

In addition, over 60 worksheets have been delivered to the Maple application centre.

## 3.5 Category III Papers

### 3.5.1 Description of Category III (Unrefereed) Vehicles

Since unrefereed papers do not 'count' on an academic c.v. (and they should not), I must explain why I occasionally publish in unrefereed vehicles.

From 1996 to 1998 I was Editor-in-Chief of the ACM Sigsam Bulletin (Communications in Computer Algebra). Under my leadership, we began to publish formally reviewed articles. I chose to publish several high-quality papers of my own in the Bulletin, as part of a general attempt to raise the tone. Of course there was no mechanism for reviewing the Editor-in-Chief's papers, so mine counted as unrefereed.

This was a deliberate choice: I could have submitted many of my papers in the Bulletin to other, refereed, journals; I believed them to be of sufficient quality, but I chose instead to

encourage increased readership of the Bulletin by publishing them only there. Such resubmission would not have violated copyright: currently the Bulletin does not hold copyright of papers published there. I encourage you to read the Bulletin, to see if you agree with my choice.

### 3.5.2 List of Category III papers

This list includes technical reports not yet reviewed and published elsewhere. I have tried to avoid duplication, and removed technical reports as they get published elsewhere.

1. Robert M. Corless & Nargol Rezvani, "The Nearest Polynomial of Lower Degree", Technical Report TR-06-03, at http://www.orcca.on.ca/TechReports.

2. Nargol Rezvani & Robert M. Corless, "The nearest singular polynomial with a given zero, Revisited", SIGSAM BULLETIN vol. 39, no. 3, Sept. 2005, 73–79.

3. Ashley B. Pitcher & Robert M. Corless, "Quasipolynomial root-finding and applications", Technical Report TR-05-04, at http://www.orcca.on.ca/TechReports. Appeared as a poster at MITACS 2005.

4. Ashley B. Pitcher & Robert M. Corless, "Quasipolynomial root-finding: A numerical homotopy method", Technical Report TR-05-03, at http://www.orcca.on.ca/TechReports. Also appeared in the proceedings of the Canadian Undergraduate Mathematics Conference, Queen's, 2005.

5. Robert M. Corless, "Maple in the physical sciences", invited tutorial in Proc. Maple Summer Workshop, Wilfrid Laurier University July 2004, on CD.

6. A. Amiraslani, Robert M. Corless, L. Gonzalez-Vega, & A. Shakoori, "Polynomial Algebra by Values", Technical Report TR-04-01, at http://www.orcca.on.ca/TechReports.

7. Robert M. Corless, H. Kai, & Stephen M. Watt, "Approximate Computation of Pseudovarieties", SIGSAM BULLETIN vol. 37, no. 3, issue 145, Sept. 2003, 67-71

8. Mhenni Benghorbal & Robert M. Corless, "The $n$th derivative", SIGSAM BULLETIN Vol. 36, no. 1, 10-14, 2002

9. Robert M. Corless, "Closures of branch cuts for elementary functions in Maple 7" ORCCA Technical Report TR-01-08, at http://www.orcca.on.ca/TechReports

10. Robert M. Corless, "An elementary solution of a minimax problem arising in mesh selection", SIGSAM BULLETIN Vol 34, No. 4, Issue 134, (Dec. 2000), *pp. 7–15.*

11. Robert M. Corless, James H. Davenport, D.J.Jeffrey, & Stephen M. Watt, "According to Abramowitz & Stegun, or Arcoth needn't be uncouth", SIGSAM BULLETIN Vol 34, No. 2, Issue 132, (June 2000), *pp. 58–65.*

12. Robert M. Corless "HIV and Antiviral therapy", ORCCA Technical Report TR-00-22 (2000).

13. Robert M. Corless & D.J.Jeffrey, "Still more fun results on the Lambert $W$ function", ORCCA Technical Report TR-00-20 (2000).

14. Xianping Liu, Robert M. Corless, & K. O. Geddes, "Computation of Center Manifolds", ORCCA Technical Report TR-00-15 (2000).

15. Robert M. Corless & Josef Schicho, "Iterated Improvement using the SVD for Singular Linear Systems", ORCCA Technical Report TR-00-09 (2000).

16. Robert M. Corless & Stephen M. Watt, "Software Tools for Mathematical Communication (Success Stories)", ORCCA Technical Report TR-00-14 (2000). Proceedings on the Future of Mathematical Communication, Mathematical Sciences Research Institute, Berkeley, December, 1999; http://www.msri.org/publications/videos.

17. Robert M. Corless & Stephen M. Watt, "Report on the SNAP minisymposium at SIAM '98", SIGSAM BULLETIN Vol 32, No. 2, Issue 124, (June 1998), *pp. 35–37.*

18. Robert M. Corless & D.J.Jeffrey, "Graphing elementary Riemann surfaces", SIGSAM BULLETIN Vol 32, No. 1, Issue 123, (March 1998), *pp. 11–17.*

19. Robert M. Corless & D.J.Jeffrey, "The Turing Factorization of a Matrix", SIGSAM BULLETIN Vol 31, No. 3, Issue 121, (Sept. 1997), *pp. 21–29.*

20. Mohammad O. Ahmed & Robert M. Corless, "The Method of Modified Equations in Maple", in the Electronic Proceedings of the 3rd International IMACS conference on Applications of Computer Algebra, Maui, July 24–26, 1997, Michael Wester & Stanly Steinberg, editors, `http://math.unm.edu/ACA/1997.html`.

21. Robert M. Corless, "Gröbner Bases and Matrix Eigenproblems", SIGSAM BULLETIN Vol. 30, No. 4, Issue 118, (Dec. 1996), *pp.* 26–32.

22. Robert M. Corless & D.J.Jeffrey, "The Unwinding Number", SIGSAM BULLETIN Vol. 30, No. 2, Issue 116, (June 1996), *pp.* 28–35.

23. Robert M. Corless, "Cofactor Iteration", SIGSAM BULLETIN Vol. 30, No. 1, Issue 115, (March 1996), 35–38.

24. Anne-Marie E. Allison & Robert M. Corless, "Prediction of Closed-Loop Hysteresis with a Flow-Induced Vibration Model", Proceedings CANCAM '95, Victoria, vol 2, (1995) 512–513.

25. T. Chen, Robert M. Corless, & H. Rasmussen, "A Numerical Study of flow past circular cylinder using vortex method", Proc. 3rd Annual CFD Society of Canada, Banff, June 25–27, vol 1, (1995) 409–413.

26. Robert M. Corless & K. El-Sawy, "Solution of banded linear systems of equations in Maple using LU factorization", Proceedings of the Maple Summer Workshop, Robert J. Lopez, ed, Rensselaer Polytechnic Inst., Troy, NY, August 9–13 (1994) 219–227.

27. Robert M. Corless, "What is a solution to an ODE?" SIGSAM BULLETIN , Vol. 27, No. 4, Issue 106, (Dec. 1993) 15–19.

28. Robert M. Corless & D.J.Jeffrey, "Well, it isn't quite that simple", SIGSAM BULLETIN, Vol. 26, no 3., issue 101, (1992) 2–6.

29. Robert M. Corless & D.J.Jeffrey, "A Comparison of Three Computer Algebra Systems for the Solution of a Problem in Hydrodynamic Lubrication", SIGSAM BULLETIN Vol. 22, No. 2, (1988), 50–62.

30. Kenzu Abdella, Robert M. Corless, D.J.Jeffrey, & H. Rasmussen, "Shear-flow instability at the interface between two fluids", AM-92-01, Applied Math, University of Western Ontario.

31. Robert M. Corless & David Naylor, "Heat Transfer Between Concentric Cylinders", AM-91-02, Applied Math, University of Western Ontario, 1991.

32. Robert M. Corless, "A Feasibility Study for the use of COLSYS in the solution of Partial Differential Equations", Tech. Rept. CS-82-32, Computer Science Department, University of Waterloo, 1982 [*Sci. Comp.*].

# 4 Students and PDFs

## 4.1 Completed Graduate students

| | | |
|---|---|---|
| J. Zhao | PhD 2006 | Accurate Compact Finite Difference Method & Applications |
| M.-P. Gagne-Portelance[5] | PhD 2006 | Computing Feynman Integrals on Non-Commutative Spaces |
| A. Amiraslani[6] | PhD 2006 | New Algorithms for Matrices, Polynomials, and Matrix Polyn |
| N. Rezvani | MSc 2005 | Approximate Polynomials in Different Bases |
| S. Ilie[4] | PhD 2005 | Computational complexity of numerical solutions of IVP for I |
| M. Benghorbal | PhD 2004 | Power Series Solutions of Fractional Differential Equations |
| H. Zhong[1] | PhD 2001 | Non-harmonic Fourier Series |
| X. Liu | PhD 1999 | Symbolic tools for nonlinear dynamics |
| A. E. Allison | PhD 1998 | Analytical Investigation of a FIV model |
| M. O. Ahmed[2] | PhD 1997 | Compact methods for PDE |
| A. Shakoori | MSc 2003 | Solving Bivariate Polynomials by Eigenvalues |
| D. Liu[3] | MSc 2001 | A Notation Selection Tool (Comp. Sci.) |
| X. Xie[3] | MSc 2001 | Symbolic Circuit Analysis in Maple |
| G. Litt | MSc 2000 | (project) Elementary functions over $\mathbb{C}$ |
| X. Liu | MSc 1995 | Perturbation package to solve ODE |
| V. Vangelov[2] | MSc 1990 | (project) record of title lost |

[1] co-supervised with André Boivin, Math
[2] co-supervised with Henning Rasmussen, Applied Math
[3] co-supervised with Stephen Watt, Computer Science
[4] co-supervised with David Jeffrey & Greg Reid, Applied Math
[5] co-supervised with D. G. McKeon, Applied Math

[6] co-supervised with Dhavide Aruliah, UOIT

### 4.2 Current Graduate Students

Date indicates start of program. Titles are tentative.

| | | |
|---|---|---|
| H. Ding[1] | PhD 2003 | Solution of Nonlinear Matrix Equations |
| A. Shakoori[2] | PhD 2003 | Multiplicity and Confluency for Polynomial Systems |

[1] co-supervised with David Jeffrey, Applied Math
[2] co-supervised with Dhavide Aruliah, UOIT

### 4.3 Postdoctoral Fellows

| | |
|---|---|
| Dhavide Aruliah | 2002–2004 |
| Hiroshi Kai | 2002–2003 |
| Lihong Zhi | 2001–2002 |
| Ilias S. Kotsireas | 1999–2001 |

All postdocs were co-supervised with Stephen Watt, ORCCA Director.

## 5 Recent Invited Talks

I have given over 75 talks, most of which were invited, by which I mean I received a formal invitation with travel support. I give some representative descriptions below.

1. SNC July 2005, Xi'an, China "The influence of geometry on a Generalized Companion Matrix in the Lagrange Basis"

2. COSCOMP June 2005, Vienna, Austria, "Numerical Nonlinear Algebra"

3. EACA July 2004, Santander, Spain "On a Generalized Companion Matrix in the Lagrange Basis".

4. TIME June 2004, Montréal, Canada "Computer-Mediated Thinking"

5. "The Wright:-omega package in Maple: internals", Maplesoft, February 23, 2004.

6. "The Riemannian SVD and Other Approaches to Dealing with Structure", with A. Amiraslani, MITACS NCE 5th IT-Theme Meeting, Banff, Alberta, October 19-20, 2003.

7. "QR Factoring for a Practical Approximate GCD of Univariate Approximate Polynomials", SIAM Conf., Montreal, June 19, 2003.

8. "On the Lambert $W$ Function", The State University of St. Petersburg, Russia, February 2003.

9. "Elementary Functions in an Automatic Symbolic Context: Closure, Continuity and Correctness, SFU Workshop on Special Functions in the Digital Age, January 23-24, 2003.

10. "Computer Mediated Thinking", Esso Centre for Mathematics Education, UWO, London, CA, April 21, 2001.

11. "The Future of Mathematical Communication", The Mathematical Sciences Research Institute, Berkeley, California, December 1-4, 1999.

12. "Symbolic-numeric Algorithms for Polynomials: some recent results", Symbolic-algebraic and Verification Methods Meeting, Dagstuhl, Germany, November 21-26, 1999.

13. "Open Problems in Computer Algebra", 5th Spanish Computer Algebra Meeting (EACA), Santa Cruz de Tenerife, September 8-11, 1999.

14. "Symbolic Analysis at Western", MITACS Days, Vancouver, Aug 1-3, 1999.

15. "Emerging Tools in Experimental Mathematics", U. of Cantabria, Spain, June 1999.

16. "Approximate Polynomial Decomposition", FRISCO Workshop, Oxford, UK, February 1999.

17. "Symbolic Numeric Algorithms for Polynomials", U. of New Brunswick, Fredericton, NB, October, 1998

18. "A Survey of Taylor Series Methods in CAS", ANODE '98, Auckland, NZ

19. "Analysis with Computer Algebra" ECCAD '98, U.S. Naval Academy, Annapolis, MD, April 25, 1998.

20. "Analysis with Computer Algebra", Workshop on Symbolic Computation at CRM, Montréal, Sept 20–27, 1997. This workshop was part of the Theme Year on Statistics.

21. "The reordered Schur factorization for zero-dimensional systems of multivariate polynomial systems with multiple roots"

    (a) The University of Cantabria, Santander, Spain, June 1997.

    (b) Department of Computer Science, The University of Waterloo, March 14, 1997

22. "Cofactor Iteration", SNAP '96, Sophia-Antipolis, France, July 15–17, 1996.

23. "Birkhoff-type Wake Oscillators in Flow-Induced Vibration Models", 16th Canadian Applied Mathematics Society Meeting, May 31–June 2, Winnipeg.

24. "The Dynamics of the Lambert $W$ Function."

    (a) Dynamical Systems Day, University of Waterloo, December 3, 1996.

    (b) Departmental Retreat, Mathematics Dept. ETH Zürich, Valbella, Switzerland, July 25, 1996.

(c) 50th Anniversary Meeting of the Canadian Mathematics Society, Experimental Mathematics Session, Simon Fraser University Harbour Centre Campus Dec 9–11, 1995.

(d) Workshop on nonlinear dynamical systems and symbolic computation, RIACA, Amsterdam, June, 1995.

25. "Symbolic Computation and Numerical Analysis", 1st Spanish Computer Algebra Meeting, The University of Cantabria, Santander, Spain, Sept. 1995.

26. "On the Lambert $W$ Function"

(a) Department of Mathematics, Trent University, Fall 1997.

(b) Mathematical Sciences Seminar, The University of Cantabria, Santander, Spain, June 1997.

(c) Computer Science Department, University of Toronto, Dec 9, 1996.

(d) Aeronautics Institute at the Warsaw University of Technology, July 1995.

(e) Mathematics Dept., The University of Northern British Columbia, April 1995.

(f) IBM T. J. Watson Research Center, May 1994.

27. "Lambert's $W$ Function: Diverse Applications and a Singular Implementation," East Coast Computer Algebra Day, Drexel University, Philadelphia, May 1994.

28. "Continued Fractions: The Royal Road to Chaos"

(a) Fractal Friday, Simon Fraser University, March 1995

(b) Fractals and Chaos, Fields Institute Workshop, February 1995

29. "What Good are Numerical Simulations of Chaotic Dynamical Systems?" (four-lecture series)

(a) NASA Ames, January 1995.

(b) Penn State, workshop on Chaos and Statistics, July 1994.

(c) International Summer School "Let's Face Chaos through Nonlinear Dynamics", University of Ljubljana, Ljubljana, Slovenia, Sept. 1993.

30. "Symbolic Computation in Nonlinear Dynamics", International Summer School "Let's Face Chaos through Nonlinear Dynamics", University of Ljubljana, Ljubljana, Slovenia, Sept. 1993.

31. "Error Backward", 2nd International Conference on Chaos and Numerics, Geelong, Australia, July 1993.

32. "An Experimental Interval Arithmetic Package in Maple", Symbolic Computation Group, University of Waterloo, February 1993.

33. "Bifurcation in a Flow-Induced Vibration Model", Fields Institute Workshop on Normal Forms and Homoclinic Chaos, Waterloo, Nov. 1992.

# 6 Other Writings and Scholarly Activity

## 6.1 The Lambert $W$ Function Poster

With funding from Gaston Gonnet (ETH Zürich), from Maplesoft, and with considerable help from D.J.Jeffrey, I designed, created and printed several thousand copies of *The Lambert W Function Poster*. A pdf version of the poster can be seen at `http://www.orcca.on.ca/LambertW`. Mary Read, a graphic designer working for UWO, was also very helpful. Many copies have been distributed to schools, and to universities in various countries.

## 6.2 Organic Mathematics

I wrote two papers for this proceedings: one was an overview of the whole project (I was the Chair of the workshop and one of the proceedings editors), and the other was the technical paper "Continued Fractions and Chaos", which was adapted from my monthly article (Ref. 41, page 10], with several new appendices added and 'live' or 'activated' or 'organic' examples added.

1. Jonathan M. Borwein, Peter B. Borwein, Robert M. Corless, Loki Jörgenson, & Nathalie Sinclair, "What is Organic Mathematics", Proc. Organic Mathematics Workshop, Simon Fraser University, Vancouver, Dec. 12–14, 1995, Borwein, Borwein, Corless, & Jörgenson, eds.

2. Robert M. Corless, "Continued Fractions and Chaos", Proc. Organic Mathematics Workshop, Simon Fraser University, Vancouver, Dec. 12–14, 1995.

These may be found at `http://www.cecm.sfu.ca` under the item "Proceedings of the Organic Mathematics Workshop". The hardcopy version (CMS Proceedings volume 20) is now available.

## 6.3 Books and Chapters

1. D.J.Jeffrey & Robert M. Corless, "Linear Algebra in Maple", chapter in the CRC Handbook of Linear Algebra, to appear 2006.

2. Robert M. Corless, Erich Kaltofen & Stephen M. Watt, "Hybrid Methods", in The Computer Algebra Handbook, Springer, eds. J. Grabmeier, E. Kaltofen, & V. Weispfenning, December 2002, 113-125.

3. Robert M. Corless, *Essential Maple*, Springer-Verlag, New York, 1995. Now in 2nd Edition.

4. Robert M. Corless, "First Encounters of an AXIOM-XL Novice", in the AXIOM-XL library compiler User Guide, NAG, 1994, *pp.* 293–320.

### 6.3.1 Books in Progress

1. Robert M. Corless & D.J.Jeffrey, "On the Lambert $W$ function", 350pp est, to be published by Springer-Verlag.

## 6.4 Book Reviews

1. Robert M. Corless, "A review of Modern Computer Algebra, by Joachim von zur Gathen and Jurgen Gerhard", SIGSAM Bulletin Vol 35, no. 1, Issue 135, 2001.

2. Jonathan M. Borwein & Robert M. Corless, "The Encyclopedia of Integer Sequences by Sloane and Plouffe", SIAM Review, SIAM Review **38** No. 2 *pp.* 333–358 (June 1996).

3. Robert M. Corless, "Differential Equations with Maple V", by M. L. Abell and J. P. Braselton, SIGSAM BULLETIN vol 30 no. 1, March 1996 pp. 57–60.

## 6.5 Editorial Work

### 6.5.1 Journal of Symbolic Computation

In August 2003 I was asked to join the editorial board for the JSC. The work so far has not been onerous, but steady.

### 6.5.2 SIGSAM BULLETIN

From 1992 until 1996 I was an Associate Editor for the SIGSAM BULLETIN. I accepted the position of Editor in April 1996, and continued till I was elected to the position of Chair of ACM Sigsam in 1998. Starting with issue 117 the Bulletin contains formally reviewed articles.

### 6.5.3 Organic Mathematics

"Organic Mathematics" means mathematics connected to the Web, and to symbolic computation software. As one of the Proceedings Editors, I was responsible for proofreading, for coordination of reviewing and 'vivification' teams, for software design, and for grant applications to support this work. This is also discussed in my Teaching Dossier, but several of the papers in the Proceedings were research papers by leading mathematicians, and so it is also appropriate to mention this here.

### 6.5.4 Refereeing

I have been an NSERC grant application reviewer for the Computer Science, Mathematics, and Mechanical Engineering Committees; I have been a National Science Foundation grant application reviewer for the Computer Science committee; I have been a reviewer for the Austrian Science Foundation (FWF).

I am a regular book and proposal reviewer for Oxford University Press, Academic Press, and Springer-Verlag.

I have been a referee for the following journals and conferences. American Mathematical Monthly, SIAM Workshop on Automatic Differentiation, J. Comp. Physics, Computing Reviews, Interval Computations, Fields Institute Workshop on Normal Forms and Homoclinic Chaos, J. Fluids and Structures, ISSAC, MapleTech, Math. Comp., J. Math. Analysis & Applications, SIAM J. Numer. Analysis, SIAM J. Sci. Stat. Comput., and J. Symbolic Computation.

### 6.5.5 External Examinerships

The following list is incomplete.

| | |
|---|---|
| Wei Xu | Computing And Software, Ph.D. 2006 McMaster |
| Wayne Hayes | Comp. Sci., Ph.D. 2000 Toronto |
| Kaijun Zhan | Math & Computer Science, Ph.D. 1996 Guelph |
| Ruxandra Botez | Mechanical Engineering, Ph.D. 1994 McGill |

## 6.6 Computer Conferencing

- mapledev (Symbolic Computation Group)
- Mathematics Education Forum (from the Fields Institute)
- Maple User's Group
- numeric-interest
- interval-computations (now reliable-computing)

## 6.7 Organizational Memberships

I have a lifetime membership in the Canadian Applied Mathematics Society. I am also a member of the Mathematical Association of America, Society for Industrial and Applied Mathematics, and the Association for Computing Machinery Special Interest Group in Symbolic and Algebraic Manipulation, of which I am now Past Chair.

# 7 Grants

This section is now very complicated, and details are omitted. I was a principal in several very large grants (totalling several millions) in the founding of ORCCA, the Ontario Research Centre for Computer Algebra. The funding sources included NSERC through a CRD grant, the Ontario Research and Development Challenge Fund, MITACS, Canarie, and Waterloo Maple Incorporated. For the purposes of this cv, I record only my NSERC discovery grant. I now go through the CS 331 committee (I changed in 2002 from Mechanical Engineering).

## 7.1 NSERC Discovery/Operating Grants

| | |
|---|---|
| 2005-10 | $40,000/yr |
| 2002-04 | 35,000/yr |
| 1997-01 | 21,000/yr |
| 1994-97 | 13,000/yr |
| 1990-93 | 15,000/yr |
| 1989-90 | 10,000/yr |
| 1987-89 | 9,400/yr |

# 8 Administrative Work

## 8.1 Chair of Applied Math July 1, 2002–June 30, 2007

The Chair holds the lead administrative position in the Department. The most important aspects of this position are

1. Academic and Budget Planning
2. Recruitment and Retention of faculty members, staff, and graduate students
3. Managing the Graduate Experience
4. Managing the Undergraduate Experience
5. External Relations (principally within the University)
6. Ensuring compliance with the Collective Agreement

For both Academic and Budget planning I have been active on the Faculty of Science planning committees, ensuring that Applied Mathematics had a voice in the Faculty of Science planning process. Our Department does research in all five main themes of the Faculty of Science, and because of that it is important that we play a significant role in the planning process. On the budget side, I estimate that I have increased the Department budget by over 40% during my tenure as Chair. Space for the department was substantially increased in our move to Middlesex College, improving especially the graduate student offices and the labs.

For Recruitment and Retention, I have co-ordinated the hiring of four faculty members out of 16 at the time of writing and will have hired two more by the time my Chairship expires. I have worked very hard to ensure that members of this Department are paid their fair market compensation. Sometimes, other issues are involved in retention: spousal hires, changing the direction of the Department to ensure that a valued colleague feels valued, or simply making sure that outstanding performance is recognized, perhaps by an award. During my tenure as Chair, awards to my faculty members have included the Marilyn Robinson award for teaching; the Faculty of Science Distinguished Research Professor award; the Petro-Canada Young Investigator Award; several PREA/ERA; the Florence Bucke Science Prize, and others. Sometimes retention is an issue more of relationships, of listening and giving needed support and occasionally criticism, and I have spent considerable time doing that. On the staff side, I have managed a complete turnover in the office staff: our senior AO retired, and I rotated (with due process) the other two into the higher positions, and hired a replacement. Doing this correctly is crucial for the performance of the Departmental duties, and I am happy with the outcome today, which is more than satisfactory.

With regard to graduate experience, I have put our best and most motivated people into the position of Graduate Chair (successively), and backed them and their decisions. I have done my best to lead by example, supervising many graduate students, and worked very hard to ensure that the overall graduate student environment was warm and welcoming. The event of which I am most proud was that the number of women in our Ph.D. program

reached the fifty percent mark (12 of 24) for the first time in the history of the Department during my tenure as Chair. Although I obviously cannot take full credit for that, I can state that this was intentional, and at least partially the result of a deliberate policy of increased recruitment.

For enhancing the undergraduate experience, I have concentrated on putting our best teachers into the courses that lead to our programs, and by doing my best to ensure that quality teaching is being delivered (and that quality teachers are rewarded). I have engaged several Limited-Duties personnel, and removed the ones who did not perform well. I have had to support some teachers who were so aggressive in their requirements for the students that the students (and Chairs of other departments) complained—but who were doing an excellent job of making their students master the material. I have put forward several teaching contributors for teaching awards. I have also put myself personally on the front line, whenever possible, teaching first-year calculus for the engineers and second year differential equations.

For external relations, I have spent time on Senate, and on several high-level committees (selection committees for various Deans, in particular), and taken part in the Leaders conferences. These have proved invaluable for building relationships across campus and promoting interdisciplinary activity. My honorary professorship in Philosophy was a direct result of one of these committees (together with the fact that I helped teach a Philosophy course on gravity, one year).

Ensuring compliance with the Collective Agreement is a vital piece of the job. In some cases, this leads to outright removal of someone, even a tenured full professor, who isn't doing their job as required by the Agreement. In other cases, this provides vital protection to, for example, limited-duties (sessional) instructors. In all cases, the Agreement provides the framework for getting our jobs done, down to the level of specifying when the teaching assignments must be done. I have become very familiar with the provisions of the agreement, especially those to do with Promotion and Tenure. At this time of writing, I have prepared and defended six cases for Tenure or Promotion successfully. I have also participated in P&T committees across campus, itself a valuable experience in administration.

There have been hard things to do, as Chair. I have had the unpleasant duty of writing or helping to write obituaries for several of my colleagues, most recently that of Vic Elias. I have had to manage the responses to illness, divorce, or other misfortunes. I have had to deal with serious personal disagreements. Luckily, I have not had to deal with actual "Discipline" cases, but I have been prepared to do so.

On the whole, though, the pleasant duties of the Chair—nominating people for awards, hiring people, or simply dealing with such successful people as those in my Department—far outweigh the unpleasant duties, and I have found it a personally rewarding experience.

## 8.2 Deputy Director of ORCCA 1999–2004

As Deputy Director of the Ontario Research Centre for Computer Algebra, I was responsible for negotiating the main contract under which our industrial partner's support was delivered to be matched by government and University funding. The hardest things to work out were the intellectual property issues, and I learned a lot in that process. The most important 'soft' lesson learned was the importance of building personal relationships, and how to manage

those in a business-university-government environment.

I was also largely responsible for recruitment: of faculty members, of Ontario Research Chairs, of postdoctoral fellows, of staff, and of course graduate students. I was directly involved in the internal review process through our Industrial Liasion Committee, writing reports, and troubleshooting problems. I was the principal budget officer for the Centre.

## 8.3 Other service

1. 2005–2007 Member-at-large, CAIMS Board of Directors
2. 1998–2002 Chair, ACM Special Interest Group on Symbolic and Algebraic Manipulation
3. 1999–2000 Chair, ISSAC Steering Committee

## 8.4 Conferences Organized

| | | |
|---|---|---|
| 2004 | SONAD (UWO) | co-chair with D. Aruliah |
| 2003 | SIAM (Montréal) SNAP mini | with D. Aruliah |
| 2002 | ISSAC (Lille) | Poster Chair |
| 2000 | SONAD (UWO) | Chair |
| 1999-2001 | ISSAC | Chair of Steering Committee |
| August 1998 | ISSAC '98, Rostock, Germany | program committee vice-chair |
| July 1997 | ISSAC '97, Maui | publicity co-chair |
| May 1997 | CAMS '97 | committee member |
| May 1997 | CAMS '97 minisymposium | on Technology in Mathematics Education |

| | | |
|---|---|---|
| July 1996 | Symbolic-Numeric Algorithms for Polynomials | |
| May 1996 | Southern Ontario Flow-Induced Vibration Day | Chair |
| April 1996 | Southern Ontario Numerical Analysis Day | Chair |
| April 1996 | UWO Computer Algebra Day | Chair |
| December 12-14, 1995 | Organic Mathematics Workshop, SFU | Chair |
| December 5, 1995 | SFU Computer Algebra Day | Chair |
| July 1995 | ICIAM Minisymposium, Hamburg<br>Symbolic+Numeric=Scientific Computing | Chair |
| March 1995 | Fractal Friday, SFU | Chair |
| May 1992 | Southern Ontario Numerical Analysis Day | Chair |

# 9 Contact & Personal Information


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